## CHAPTER IV: METHODOLOGY

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4.1 INTRODUCTION

This chapter on methodology explains about restatement of problem objectives, variables, hypothesis, design of the study, research and experimental procedure, sample, tools, reliability and validity of tools, data collection, scoring and method of analyzing the data using appropriate statistical techniques in the present investigation.

4.2 RESTATEMENT OF THE PROBLEM

Students are the grass roots of any nation. It is imperative to make them technically sound and professionally confident create the knowledge society. This formidable task of nation building can be achieved only with the help of hybrid learning environments. It is the hour to think of various possibilities of integrating the conventional face to face classroom environment with small groups learning environment. Hence the problem of the present study may be stated as “Effect of Small Groups Learning on Students’ Performance in Science at High School Level”.

4.3 OBJECTIVES OF THE STUDY

The following are the objectives of study

1. To prepare a tool to assess the achievement of High School students in Science.
2. To study the achievement of High school students in science learning through small groups learning with respect to their personal variables.
3. To study the Scientific temper of High school students learning through small groups learning with respect to their personal variables.
4. To study the Creativity of High school students learning through small groups learning with respect to their personal variables.
5. To evaluate the effectiveness of small groups learning in science subjects.
6. To find out the relationship between the Achievement and Creativity of high school students learning through small groups learning.

7. To find out the relationship between the Scientific temper and Achievement of high school students learning through small groups learning.

8. To find out the relationship between the Creativity and Scientific temper of high school students learning through small groups learning.

4.4 VARIABLES OF THE STUDY

The independent variable of study is the small groups learning strategy. The dependent variable is the achievement of High school students in science. The other variables involved in this study are scientific temper and Creativity. These variables are studied with respect to gender, locality, and parents qualification.

4.5 HYPOTHESES OF THE STUDY

The following hypotheses were formulated based on the objectives and variables of the study.

1. There is no significant difference in the achievement in science between the control and experimental group of High school students.

2. There is no significant difference in the achievement in science between the Boys of Control and Experimental group of High school students.

3. There is no significant difference in the achievement in science between the Girls of Control and Experimental group of High school students.

4. There is no significant difference in the achievement in science between the Rural students of Control and Experimental group of High school students.

5. There is no significant difference in the achievement in science between the Urban students of Control and Experimental group of High school students.
6. There is no significant difference in the achievement in science between the Control and Experimental group of High school students with their Parents qualified up to SSLC.

7. There is no significant difference in the achievement in science between the Control and Experimental group of High school students with their Parents qualified above SSLC.

8. There is no significant difference in the Scientific temper between the control and experimental group of High school students.

9. There is no significant difference in the Scientific temper between the Boys of Control and Experimental group of High school students.

10. There is no significant difference in the Scientific temper between the Girls of Control and Experimental group of High school students.

11. There is no significant difference in the Scientific temper between the Rural students of Control and Experimental group of High school students.

12. There is no significant difference in the Scientific temper between the Urban students of Control and Experimental group of High school students.

13. There is no significant difference in the Scientific temper between the Control and Experimental group of High school students with their Parents qualified up to SSLC.

14. There is no significant difference in the Scientific temper between the Control and Experimental group of High school students with their Parents qualified above SSLC.

15. There is no significant difference in the Creativity between the control and experimental group of High school students.

16. There is no significant difference in the Creativity between the Boys of Control and Experimental group of High school students.

17. There is no significant difference in the Creativity between the Girls of Control and Experimental group of High school students.
18. There is no significant difference in the Creativity between the Rural students of Control and Experimental group of High school students.

19. There is no significant difference in the Creativity between the Urban students of Control and Experimental group of High school students.

20. There is no significant difference in the Creativity between the Control and Experimental group of High school students with their Parents qualified up to SSLC.

21. There is no significant difference in the Creativity between the Control and Experimental group of High school students with their Parents qualified above SSLC.

22. The small groups learning strategy is not effective in improving the Achievement in science of High school students.

23. There is no significant relationship between the Achievement and Creativity of High school students.

24. There is no significant relationship between the Scientific temper and Achievement of High school students.

25. There is no significant relationship between the Creativity and Scientific temper of High school students.
4.6 METHODOLOGY

4.6.1 DESIGN OF THE STUDY

The present study is an experimental study. The research paradigm is given in table 4.1.

Table 4.1 – The Research Paradigm

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample</th>
<th>Tools</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent</td>
<td>Control group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small groups learning strategy</td>
<td>Achievement in science, Scientific temper and Creativity</td>
<td>56 High school students</td>
<td>Pre test, Post test Mean, S.D &amp; ‘t’</td>
</tr>
<tr>
<td></td>
<td>Achievement in science, Scientific temper and Creativity</td>
<td>Experimental group 53 High school students</td>
<td>Pre test, Post test Mean, S.D , ‘t’, C, r, &amp; Regression</td>
</tr>
</tbody>
</table>

4.6.2 METHOD

To study the effectiveness of small groups learning strategy, the Pre-test, Treatment, Post-test equivalent group experimental design was adopted in the study.

4.6.3 SAMPLE

The sample consisted of 56 students as Control Group from High school students of Govt. Higher Sec. School, Palavanatham at Virudhunagar district, and 53 students were as experimental group from the High school students of Govt. Higher Sec. school, Meesalur at Virudhunagar District respectively. They were selected through purposive sampling technique.
4.6.4 TOOLS

The following tools were used in the study.

Tool 1: The Achievement test in science constructed and validated by the investigator.

Tool 2: The scale of scientific temper constructed and validated by the investigator.

Tool 3: The Verbal Test of Scientific Creativity developed by Dr. V.P. Sharma and Dr. J.P. Shukla (2005).

4.7 DESCRIPTION OF THE TOOL

4.7.1 CONSTRUCTION OF ACHIEVEMENT TEST IN SCIENCE

The achievement test in science was constructed by the investigator from the topics which he planned to teach the students using small group learning strategy.

4.7.2 SYLLABUS

The investigator the revised syllabus of Tamilnadu board of school education with his research supervisor, two headmasters and four experienced teachers of High school and finalized the following topics Reaching the age of adolescence, Atomic Structure, Force and Pressure and Experiments for small group learning strategy.

4.7.3 ACHIEVEMENT TEST

Achievement test in science was constructed and validated by the investigator to assess the achievement of High school students. The test was constructed to cover four topics of science of High school standard curriculum, giving due weight age to objectives like knowledge, understanding and application as well as giving due items for the duration of one hour. Each question carries one mark.
Table 4.2: Blue print of achievement test.

<table>
<thead>
<tr>
<th></th>
<th>Knowledge</th>
<th>Understanding</th>
<th>Application</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAD (Test1)</td>
<td>15</td>
<td>5</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>TGT (Test 2)</td>
<td>10</td>
<td>7</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td>JIGSAW (Test 3)</td>
<td>12</td>
<td>7</td>
<td>6</td>
<td>25</td>
</tr>
<tr>
<td>EXPERIMENT (Test 4)</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total Marks</strong></td>
<td><strong>47</strong></td>
<td><strong>29</strong></td>
<td><strong>24</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

4.7.4 EXPERT OPINION

The test items constructed were subjected to jury’s opinion consisting of research supervisor, two Headmaster of Higher secondary school and four experienced teachers. The jury’s were requested to review each item and its validity with reference to the objectives, appropriateness and suitability to High school students. The suggestion given by they were incorporated to finalize 100 test items with maximum of 100 marks.

4.7.5 RELIABILITY

To establish the reliability of the test, the investigator adopted split – half method. The test is split into two equivalent halves by pooling the odd numbered items for one score and the even numbered items for another score. This makes the two set of scores obtained from a single test reasonably equivalent. In this way these scores for each student are
obtained, one on odd numbered items and the second on even numbered items. The correlation between the results of the two halves is determined and from these the reliability of the whole test is calculated by applying the Spearman-Brown formula which is given by 
\[ r = \frac{2r_2}{1 + r_2} \]
where ‘r’ is the reliability co-efficient of the whole test and \( r_2 \) is the reliability co-efficient of the half of the test. The investigator adopted the same procedure taking 25 percent of the total sample of 109 students. The reliability of the whole test is found to be 0.86 significant at 0.01 levels. Hence it is concluded that the test is highly reliable.

4.7.6 VALIDITY

To establish the validity of the test the investigator attempted to find out the correlation co-efficient between the achievement scores in the test and scores they got in their quarterly examination by product moment corer relation method using percentage of the total sample of 109 students. The correlation co-efficient is found to be 0.831 significant at 0.01 level. Hence it is concluded that the test high concurrent validity.

4.8 SCIENTIFIC TEMPER SCALE

The act of searching gives the rays of hope for learning. World Wide Web is a place where seekers and learners alike bonded together in search for knowledge. The unquenchable thirst of learning mass in search of information in the electronic media and science text book has been termed as Scientific temper by the investigator What for the individuals are searching or what skill that they feel will improve over browsing have been collectively named as Scientific temper. The investigator intended to study the influence of small groups learning strategy over scientific temper and to measure the relationship. Scientific temper was assessed by using scientific temper scale constructed by the investigator. There are various factors which make the individual surf in the net and text. The investigator had identified ten
such factors as ten dimensions of the tool and test contains 50 statements with three point scale.

4.8.1 TEST CONSTRUCTION

The test items were generated based on opportunity to learn, ability to understand, chances for collaborative learning, Meta cognitive skills and social learning.

Ten dimension of scientific temper

1. Content

Content refers to enormous amount of digital content science text books content that can be transmitted over a computer network such as television and internet etc. It includes text, audio, video, graphics, animation and so on.

2. Performance

Performance refers to the ability to carry out or the act of execution or sense of accomplishment or achievement. Those who assume that their performance increases through media favour the dimension performance.

3. Simulation

The act or an instance of simulating with the assumption of false appearance, form or sequence is simulation. Facing the representation of a problem situation in order to estimate its characteristics or solve problem is simulation. Those who prefer a feign experience or an act of factious assumption prefer this dimension.
4. Collective intelligence

Collective intelligence refers to shared or group intelligence that emerges from the collaboration and competition of many individuals and appears to be essential for decision making. In order to allow relatively large number of people to cooperate in one process leading to a reliable action.

5. Judgment

Judgment refers to the cognitive process of reaching a decision or drawing conclusions. The capacity to assess situations or circumstances shrewdly and to draw sound conclusions. An opinion formed by judging something is essential for new age learning.

6. Group dynamics

Group dynamics refers to the underlying features of group behavior such as motives and attitudes. It concerned with the flexibility in thinking rather than stability in thinking. The interactive process with in group about the changing patterns of tension, conflict, adjustment and cohesion.

7. Research aptitude

Research aptitude refers to an innately or learned or developed component of a competency to do a kind of research work at certain level. Research aptitude represents knowledge or ability that is gained through the internet learning environment.

8. Group dynamics

Group dynamics refers to the underlying features of group behavior such as motives and attitudes. It concerned with the flexibility in thinking rather than stability in thinking. The
interactive process with in group about the changing patterns of tension, conflict, adjustment and cohesion.

9. Cyber relationship

Cyber relationship means a relationship that was generated or continued solely through the internet as a medium for meeting of communication. The relationship anonymously connect the people to share experiences, get feedback, give comment, meet new friends and board in discussion forum.

10. Research aptitude

Research aptitude refers to an innately or learned or developed component of a competency to do a kind of research work at certain level. Research aptitude represents knowledge or ability that is gained through the internet learning environment.

4.8.2 EXPERT OPINION

The test items constructed were subjected to jury’s opinion consisting of research supervisor, two Headmaster of Higher secondary school and four experienced teachers. The jury’s were requested to review each item and its validity with reference to the objectives, appropriateness and suitability to High school students. The suggestion given by them were incorporated to finalize test items.

4.8.3 PILOT STUDY

The refined test items were administered to a sample of 25 students. The test items total correlation of each item was computed. The 50 items with significant ‘r’ values were selected and included in the final test.
4.8.4 RELIABILITY

The reliability of the test was established by test re-test method. The test was administered after a gap of three weeks to 25 High school students. The coefficient of correlation between the two set of scores was found to be 0.81. The reliability of the test was established by using split half method also. The coefficient of correlation between the scores of the odd and even items was calculated for 25 students. Split half reliability was found to be 0.76 and using Spearman-Brown formula for the full length of the test ‘r’ was estimated to be 0.78. Thus the scientific temper scale for small groups learning strategy possesses adequate reliability.

4.8.5 VALIDITY

The content validity and construct validity was established by the investigator. The construct validity was established by the investigator and it was 0.82 for scientific temper. The test items were constructed based on opportunity to learn, ability to understand, chances for collaborative learning, Meta cognitive skills and social learning. Therefore the test possesses content, construct and face validity. This establishes the validity of the tool.

4.9 VERBAL TEST OF SCIENTIFIC CREATIVITY (V T S C)

4.9.1 DESCRIPTION OF THE TEST

The test of scientific creativity it consists of has been designed by Dr. V.P.Sharma and Dr. J.P.Shukla (2005) 12 items which have been classified into four sub-tests namely (1) Consequences Test (2) Unusual Uses Test (3) New Relationship Test (4) Just Think Why Test.

(1) The Consequences Test – The consequences test is designed on the test patterns of Guilford (1952) and Torrance (1962). In this test the familiar things are presented
in the form of hypothetical situation. The subject has to visualize a large number of possibilities to a hypothetical happening. This applies to cause consequence relationship. The subject has to think the effects of consequence whether usual or unusual, logical or illogical.

The Consequences Test consists of three hypothetical situations arising from fundamentals of science.

(i) What would happen if there is no earth in the world?
(ii) What would happen if there are no bones in human body?
(iii) What would happen if there is no air on the earth?

The situations are the hypothetical ones hence the experience is minimized. An example is given in the test book-let to make the students familiar with the test. The time allowed for the test is 15 minutes.

(2) Unusual Uses Test – The test of unusual uses has been designed on the lines of Guilford’s (1952) Brick uses Test and Torrances’s (1962) Tin Can uses Test. The present test of scientific creativity includes the names of the common objects; namely (i) Nails (ii) Water, and (iii) Leaves of plants and tress which can be use for numerous purposes. All these items are very common objects from the fields of physical and biological sciences. They do not require in any way the knowledge and skill in science; however, vertical scientific thinking is an essential requirement for attaining high on this test. The students are required to wire as many novel, interesting and unusual uses of these objects as they may think. One practice item is given in the booklet to acquaint the public with nature of activity that he has to do, the time allowed here is also 15 minutes.

(3) New Relationship Test – The New Relationship Test has been designed on the pattern of Mednick’s (192) Remote Association Test. In this activity the articles of
daily use with which the child is familiar are taken so that the may think more naturally. All the articles of this test are scientifically belonging to the same group. This New Relationships Test consists of three pairs of words, to some extent in some of their physical, chemical or biological prosperities. Student has to think as many new and novel similarities between these pairs of familiar objects from physical and biological sciences. This permits the subjects an opportunity for free play of their imagination in the production of novel, original and unusual responses. One practice item is given in the test booklet Time allowed is fifteen minutes.

(4) Just think Why Test- the Just think Why Test of scientific creativity consists of common events based on cause effect relationship. The subjects are asked to think various causes of the events.

The test contains three events namely:

(i) Under what conditions palpitation of Heart Shoots Up?
(ii) What are the reasons for non-germination of the seed?
(iii) Under what conditions a man cannot express himself?

The child has ample opportunity to imagine and to produce novel and original ideas. The time allowed 15 minutes.

The total time required to administer the whole test of Scientific Creativity is one hour in addition to 20 minutes time for general instructions and practice items. The test can be administered individually or in a group.
4.9.2 RELIABILITY AND VALIDITY OF THE TEST

The Co-efficient of stability as an index of reliability on various components of Scientific creativity as well as on the whole test has been estimated by test-retest method. This test has been validated against B. Methods Verbal test of Creative.

**TABLE: 4.3**

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Components of scientific Creativity</th>
<th>Co –efficient of Stability Rtt (N=230)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fluency (FI)</td>
<td>0.729</td>
</tr>
<tr>
<td>2</td>
<td>Fluency (Fx)</td>
<td>0.648</td>
</tr>
<tr>
<td>3</td>
<td>Originality (O)</td>
<td>0.774</td>
</tr>
<tr>
<td>4</td>
<td>Whole Test (VTSC)</td>
<td>0.730</td>
</tr>
</tbody>
</table>

As it is seen that all indices of reliability are fairly high which are indicative of high dependability and great relevance. Interfactor correlations were also computed as indices of Validity which were found very high indicating dependability and relevance.

**TABLE: 4.4** Indices of Validity: inter-factor Correlation

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Fluency</th>
<th>Flexibility</th>
<th>Originality</th>
<th>Whole Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency</td>
<td>X</td>
<td>0.9601</td>
<td>0.9491</td>
<td>0.9876</td>
</tr>
<tr>
<td>Flexibility</td>
<td></td>
<td>X</td>
<td>0.9587</td>
<td>0.9861</td>
</tr>
<tr>
<td>Originality</td>
<td></td>
<td></td>
<td>X</td>
<td>0.9880</td>
</tr>
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</table>
4.10 RESEARCH PROCEDURE:

Figure 4.1: Steps followed in the study
The students studying 8\textsuperscript{th} standard in High school, Govt. Higher Sec. School, Meesalur at Virudhunagar District were treated as experimental group, and the students studying 8\textsuperscript{th} standard in High school, Govt. Higher Sec. school, Palvanatham at Virudhunagar were treated as control group. Initially the scores secured by the students in their quarterly examination were analysed. Seventy students from each institution who secured an average range of marks were selected. Then an intelligence test of g culture fair scale 2, form B prepared by R.B. Cattel and K.S Cattel was administered to these students. Then fifty six and fifty three students were selected for each control and experimental group with matched pair.

The pre test was administrated to both the experimental and control groups and data were collected to assess the achievement, Scientific temper and Creativity of the High school students. The topics of 8\textsuperscript{th} Std science were taught to the control group with conventional method. For the experimental group the same topics were taught with small group learning strategy (Students Team Achievement Division (STAD), Team Games Tournaments (TGT), JIGSAW- II, EXPERIMENTS) for thirty days. After the treatment period the post test was administered and data were collected for achievement, Scientific temper, Creativity of the high school students.

\textbf{4.11 EXPERIMENTATION}

\textbf{Model I: Reaching the Age of Adolescence}

4.11.1 STAD (Students Team Achievement Division)

STAD are made up of five major components: Class presentations, teams, quizzes, individual improvement scores, and team recognition.

1. **Class presentation.** The teacher initially introduces the material in a class presentation. In most cases, this is a lecture/discussion, but it can include an audiovisual presentation.

   Class presentations in Student Teams-Achievement Divisions differ from usual teaching only in that they must clearly focus on the STAD unit. Thus students realize that they must pay careful attention during the presentation because doing so will help them do well on the quizzes, and their quiz scores determine their team scores.

2. **Teams.** Teams are composed of six students who represent a cross-section of the class in academic performance and sex. The major function of the team is to prepare its members to do well on the quizzes. After the teacher presents the material, the team meets to study worksheets or other material. The worksheets may be obtained from

![STAD Cycle Diagram](image_url)
the teacher-made materials. Most often, the study takes the form of students quizzing one another to be sure that they understand the content, or of students working problems together and correcting any misconceptions that may have caused teammates to make mistakes.

The team is the most important feature of STAD. At every point, the emphases are on the members doing their best for the team and on the team doing its best for the members. The team provides important peer support for academic performance; is also provides the mutual concern and respect that are important for producing such outcomes as improved intergroup relations, self-esteem, and acceptance of mainstreamed students.

3. **Quizzes.** After one to two periods of teacher presentation and one to two periods of team practices, students take individual quizzes composed of course-content-relevant questions. The quizzes are designed to rest the knowledge the students have gained from class presentations and team practice. During the quizzes students are not permitted to help one another. This ensures that every student is individually responsible for knowing the material.

4. **Individual improvement scores.** The idea behind the individual improvement scores is to give each student a performance goal that he or she can reach, but only by student a performance goal that he or she can reach, but only by working harder than in the past. Any student can contribute maximum points to his or her team in this scoring system, but no student can do so without showing define improvement over past performance. Each student is given a “base” score, the maximum score to achieve on each quiz. Then students earn points for their teams based on the amount their quiz scores exceed their base scores. After every two quizzes, base scores are recomputed – to challenge students who start performing better to improve further and to adjust to a more realistic level the base scores that were set too high for other students.
5. **Team recognition.** A newsletter is the primary means of rewarding teams and individual students for their performance. Each week the teacher prepares a newsletter to announce team scores. The newsletter also recognizes individuals showing the greatest improvement or completing perfect papers and reports cumulative team standings. In addition to or instead of the newsletter, many teachers use bulletin boards, special privileges, small prizes, or other rewards to emphasize the idea that doing well as a team is important.

**4.11.2 TGT (Team Games Tournaments)**

![Figure 4.3: TGT as a cyclic process](image)

**Model II : Atomic structure**

TGT, like STAD, is made up of five major components. However, instead of the quizzes and the individual improvement score system, TGT uses academic games and tournaments, in which students compete as representatives of their teams with members of other teams who are like them in past academic performance.

1. Class presentations. The teacher initially introduces the material in a class presentation. In most cases, this is a lecture/discussion, but it can include an audiovisual presentation. Class presentations in Teams-Games-Tournament differ from usual teaching only in that they must clearly focus on the TGT unit. Thus students realize that they must pay careful attention during the presentation because doing so will help them do well on the quizzes, and their quiz scores determine their team scores.

2. Teams. Teams are composed of four or five students who represent a cross-section of the class in academic performance and sex. The major function of the team is to prepare its members to do well on the quizzes. After the teacher presents the material, the team meets to study worksheets or other material. The worksheets may be obtained from the teacher-made materials. Most often, the study takes the form of students quizzing one another to be sure that they understand the content, or of students working problems together and correcting any misconceptions that may have caused teammates to make mistakes.

The team is the most important feature of TGT. At every point, the emphases are on the members doing their best for the team and on the team doing its best for the members. The team provides important peer support for academic performance; it also provides the mutual concern and respect that are important for producing such outcomes as improved intergroup relations, self-esteem, and acceptance of mainstreamed students.
3. Games. The games are composed of simple, course-content-relevant questions that students must answer, and they are designed to test the knowledge gain from class presentations and team practice. Games are played at tables of three students, each of whom represents a different team. Most games are simply numbered questions on a ditto sheet. A student picks a number card and attempts to answer the question corresponding to the number. A challenge rules permits players to challenge each other’s answers.

4. Tournament. The tournament is the structure in which the games take place. It is usually held at the end of the week, after the teacher has made a class presentation and the teams have had time to practice with the worksheets. For the first tournament, the teacher assigns students to tournament table: the top three students in past performance to Table 1, the next three to Table 2, and so on. This equal competition, like the individual improvement score system in STAD, makes it possible for students of all levels of past performance to contribute maximally to their team scores if they do their bets. Illustrates the relationship between heterogeneous teams and homogeneous tournament tables 4.5. After the first week, however, students change tables depending on their own performance in the most recent tournament. The winner at each table is “bumped up” to the next higher table (e.g. from Table 6 to Table 5), the second scorer stays at the same table, and the low scorer is “bumped down.” In this way, if students have been misassigned at first, they will eventually be moved up or down until they reach their true level of performance.
5. Team recognition. A newsletter is the primary means of rewarding teams and individual students for their performance. Each week the teacher prepares a newsletter to announce team scores. The newsletter also recognizes individuals showing the greatest improvement or completing perfect papers, and reports cumulative team standings. In addition to or instead of the newsletter, many teachers use bulletin boards, special privileges, small prizes, or other rewards to emphasize the idea that doing well as a team is important.
Teacher may wish to use TGT for part of their instruction, and other methods for other parts. For example, a science teacher might use TGT three days a week to reach basic science concepts but then use related laboratory exercises on the other two days. TGT can also be used in combination with STAD, either by alternating quizzes one week and tournaments the next, or by having a quiz on the day after each tournament and counting both the quiz score and the tournament score toward the team score. This procedure gives the teacher a better idea of student progress than the tournament alone.

4.11.3 JIGSAW –II

Model III: Force and Pressure


JIGSAW-II is a teaching technique invented by social psychologist Slavin 1986. Students of an average sized class are divided into competency groups of four to six students, each of which is given a list of subtopics to research. Individual members of each group then break off work with “experts” from other groups, researching a part of the material being studied, after which they return to their starting group in the role of instructor for their subcategory.

The jigsaw-II strategy is a cooperative learning technique appropriate for students from 3rd to 12th grade. It was also used extensively in adult Science classes. The strategy is an efficient teaching method that also encourages listening, engagement, interaction, peer teaching, and cooperation by giving each member of the group an essential part of play in the academic activity. Both individual and group accountability are built into the process. In
Science classrooms jigsaw-II are a four-skill approach integrating reading, speaking, listening and doing experiments.

**Benefits**

- Teacher is not the sole provider of knowledge
- Efficient way to learn
- Students take ownership in the work and achievement
- Students are held accountable among their peers
- Learning revolves around interaction with peers.
- Students are active participants in the learning process.
- Builds interpersonal and interactive skills.

**Steps of implementation**

![JIGSAW-II as a cyclic process](image)

**Figure 4.4: JIGSAW-II as a cyclic process**
According to Slavin (2008) there are ten steps considered important in the implementation of the jigsaw-II classroom:

1. Students are divided into 5 or 6 person JIGSAW-II group. The group should be diverse in terms of ethnicity, gender, ability, and race.

2. One student should be appointed as the group leader. This person should initially be the most mature students in the group.

3. The day’s lesson is divided in to 5-6 segments (one for each member)

4. Each student is assigned one segment to learn. Each student should only have direct access to their own segment.

5. Students should be given time to read over their segment at least twice to become familiar with it. Students do not need to memorize it.

6. Temporary experts groups should be formed in which one student from each jigsaw-II group joins other students assigned to the same segment. Students in this expert group should be given time to discuss the main points of their segment and rehearse the presentation they are going to make to their jigsaw-II group.

7. Students come back to their jigsaw-II group.

8. Students present their segment to the group. Other members are encouraged to ask question for clarification.

9. The teacher needs to float from group to group in order to observe the process. Intervene if any group is having trouble such as a member being dominating or disruptive. There will come a whisper to the group leader should handle this task. Teachers can whisper to the group leader as to how to intervene until the group leader can effectively do it themselves.

10. A Quiz on the material should be given at the end so students realize that the sessions are not just for fun and games, but that they really count.
Process

1. Teacher identifies a range of materials related to the topics addressed in the lessons. Consider the students who will be involved in this exercise, and, if necessary, try to identify selections of varying text difficulty and sophistication.

2. Teacher divides students into four to six jigsaw-II groups, known as the home group, and appoints one student as a leader. The group size should be dependent upon the number of selections to be assigned. The teacher divides the lesson into four to six segments. Each group member receives the task of reading one of the targeted selections. Depending on the group, the teacher may allocate the specific readings to each person, or the group itself may decide who will tackle which selection.

3. Students read the selection independently. If the materials are photocopied, encourage students to underline important information they will need to share with their group. "Sticky notes" are an option for materials that cannot be written upon. Students may also take notes, or follow a graphic note-taking outline provided by the teacher as a mean for extracting important concepts from their passage. Students should only have access and knowledge of the text related to their specific reading or assignment.

4. All of the students in the home are now “experts” on the assigned reading. They meet with their home group and discuss the concepts, highlights, and other information they feel is most important. This group might create a summary of key points, a concept map, a graphic or highlighted note which will be shared with other groups.

5. Members of the home group leave and meet with new, secondary groups. Each member of the new group has key information that no one else in the new, secondary group has. The new groups teach each other what the home group felt to be the most important and relevant information. This is where the jigsaw-II starts to come together. Members from the separate
groups have come together to teach each their assigned reading. Students are encouraged to “test” one another and ask questions for further clarification.

6. The final piece to the jigsaw-II activity involves a return meeting of the original group. During this time, individual group members share in turn the pertinent information they learned from participating the second groups. All the information come new information, which will be assessed during the evaluation of this unit of study.

There are several advantages of the jigsaw-II classroom including: teachers finding it easy to learn, teachers enjoying working with it, can be used in conjunction with other teaching strategies, can be effective even if it just used an hour per day, and it is free for the taking. It is important to know that there can be some obstacles when using the jigsaw-II classroom. One common problem is a dominant student. In order to reduce this problem, each jigsaw-II group has an appointed leader. The leader is responsible for being fair and spreading participation evenly. Students realize that the group is more effective if each student is allowed to present his or her own material before questions and comments made. Dominance is eventually reduced because students realize it is not in the best interest of the group. Another problem is a slow student in the group. It is important that each group member present the best possible report to the group and it is important that the individuals with poor study skills do not present inferior reports to their jigsaw-II group in order to reduce this problem, the jigsaw-II techniques relies on “expert” groups. Students work with other individuals form other group; they are given a chance to discuss their report. In this “expert” group, they are given a chance to discuss their reports and gather suggestions form other students to modify their reports as needed. Another issue is that of bright students becoming bored. Research suggests that there is boredom of bright students should be in the jigsaw-II classroom than in the traditional classroom. Bright students should be encouraged to develop the mind set of a teacher because this position can be exciting change into an exciting
challenge. Another problem is dealing with students that have been trained to compete. A goal of the jigsaw-II classroom is to decrease competition and increase cooperation. Research on the jigsaw-II classroom suggests that it has its strongest effect when introduced in elementary school. If there is exposure to the jigsaw-II classroom at an earlier age, than in later years only an hour per day is needed to maintain the impact of cooperative learning. When the jigsaw-II is first introduced in the later years of school, it can often be an uphill battle. Old habits can be hard to break, but over time students participating the jigsaw-II classroom in high school can benefit from the cooperative structure. An important component of the jigsaw-II classroom is that it encourages cooperation amongst students. The jigsaw-II technique goes beyond placing students into groups and telling them to cooperate. The jigsaw-II technique is a structured technique that provides crucial elements and safeguards that allow it to work better than typical techniques (Slavin, 2008).

4.11.4 EXPERIMENTS (SCIENCE)

Model IV: Experiments

Pressure exerted by liquids – Pressure exerted by air – Measurement of atmospheric pressure – Pascal’s law – friction –properties of cathode rays – Atomic models
Figure 4.5: EXPERIMENT as a cyclic process

STAD are made up of five major components: Class presentations, teams, quizzes, individual improvement scores, and team recognition.

1. **Class presentation.** The teacher initially introduces the material in a class presentation. In most cases, this is a lecture/discussion, but it can include an audiovisual presentation.

   Class presentations in Student Teams-Achievement Divisions differ from usual teaching only in that they must clearly focus on the STAD unit. Thus students realize that they must pay careful attention during the presentation because doing so will help them do well on the quizzes, and their quiz scores determine their team scores.

2. **Team experiments.** Teams are composed of six students who represent a cross-section of the class in academic performance and sex. The major function of the team is to prepare its members to do well on the quizzes. After the teacher presents the material, the team meets to study worksheets or other material. The worksheets may be obtained from the teacher-made materials. Most often, the study takes the form of students quizzing one another to be sure that they understand the content, or of
students working problems together and correcting any misconceptions that may have caused teammates to make mistakes.

The team is the most important feature of STAD. At every point, the emphases are on the members doing their best for the team and on the team doing its best for the members. The team provides important peer support for academic performance; is also provides the mutual concern and respect that are important for producing such outcomes as improved intergroup relations, self-esteem, and acceptance of mainstreamed students.

3. **Applications.** Experiments is designed for use in all grades two through eight science classes, except junior high science classes. Doing text activity of science experiments.

4. **Test.** After one to two periods of teacher presentation and one to two periods of team practices, students take individual quizzes composed of course-content-relevant questions. The quizzes are designed to rest the knowledge the students have gained from class presentations and team practice. During the quizzes students are not permitted to help one another. This ensures that every student is individually responsible for knowing the material.

5. **Individual improvement scores.** The idea behind the individual improvement scores is to give each student a performance goal that he or she can reach, but only by student a performance goal that he or she can reach, but only by working harder than in the past. Any student can contribute maximum points to his or her team in this scoring system, but no student can do so without showing define improvement over past performance. Each student is given a “base” score, the maximum score to achieve on each quiz. Then students earn points for their teams based on the amount their quiz scores exceed their base scores. After every two quizzes, base scores are recomputed – to challenge students who start performing better to improve further and to adjust to a more realistic level the base scores that were set too high for other students.
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### 4.12 INTERNAL VALIDITY OF THE EXPERIMENT

Internal validity is concerned with the extent, to which the experiment is genuinely effective, that is the extent to which the manipulation in the independent variable brings about changes in the dependent variables. It is concerned with true variations (treatment) in the independent variable.

Internal validity may be affected by a number of factors. The factors that may affect internal validity of this experiment are testing, measurement error, selection bias, and experimental mortality and interaction effects.

The experimental group and control group students in the study did not get any previous experience regarding small groups learning strategy in taking test before the treatment. So there is no possibility for the pre-test effects which may work against the internal validity of the experiment.

#### 4.12.1 SELECTION BIAS

The investigator adopted random sampling technique for this study. Initially the score secured by the students in quarterly examination were analyzed. Sixty students from each group who secured average range of marks were selected. Then an intelligence test of ‘g’
culture fair scale 2, from B prepared by R.B. Cattel and A.K.S. Cattell was administered to these students. Then 56 students who secured average intelligence score were selected for each control and experimental group with matched pair. Hence the sample, the investigator selected for this experiment was not biased.

4.12.2 EXPERIMENTAL MORTALITY

There is no loss of subjects during the experimental period and this is not a long term experiment. So the randomness or equality of groups does not suffer during this experiment.

4.12.3 INTERACTION EFFECT

In the present study the control group was selected from Government Higher secondary school Palavanatham, Virudhunagar and the experimental group was selected from Government Higher secondary school Measalur Virudhunagar the distance between the two institutions is 10k.m. So there is no possibility for the students of control group and experimental group meet together and discuss the novelty of the treatment. Thus the interaction effect was eliminated in this study.

4.12.4 ELIMINATION OF CONTAMINATION

The investigator took care to eliminate the possible contamination of the experimental factor between the students of the control and the experimental group. Considering the distance between on school and the other, the exchange of views regarding the experimental factor appeared to be remote.

4.13 COLLECTION OF DATA

The data were collected by administering pre-test and post-test of achievement, Scientific temper and Creativity. The test materials were distributed to the students and clear instructions were given to them. Scientific temper scale had three point scales and Creativity,
the students were asked to put a tick mark and written in the relevant column to express their agreement. Scientific temper scale contained 50 statements respectively.

4.14 SCORING

4.14.1 ACHIEVEMENT

The answer books of the High school students for achievement in Science were scored by giving one mark each for a right response of the objective type question, thus a range of 0-100 marks can be secured by the students.

4.14.2 SCIENTIFIC TEMPER

There were 50 statements in Scientific temper scale with three point Likert type. Each statement was assigned a weightage ranging from 1 (Yes) to 0 (No). For each student a total score on the scale can be obtained by summating his score for the individual items. Thus a range of 0-50 scores can be obtained.

4.14.3 CREATIVITY

While scoring it is to be kept in mind that each item is to be scored for fluency flexibility and originality

(i) Fluency has been scored in terms of total number of responses related to the object.

(ii) Flexibility has been scored in terms of total number of categories. Each category has been assigned one score.

(iii) Originality has been scored in terms of weights assigned in accordance with their degree of unusualness. The unusual responses has been defined as that response which has a probability of occurrence to the extent of 5% Repose which occurred
beyond 5% have been considered as common response, and hence have not been scored for originality. The scoring procedure for originality is presented in the following table.

**TABLE 4.6 : Scoring for Originality**

<table>
<thead>
<tr>
<th>Percentage of response</th>
<th>Weight assigned i.e., marks given</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1% to 1.0%</td>
<td>5</td>
</tr>
<tr>
<td>1.1% to 2.0%</td>
<td>4</td>
</tr>
<tr>
<td>2.1% to 3.0%</td>
<td>3</td>
</tr>
<tr>
<td>3.1% to 4.0%</td>
<td>2</td>
</tr>
<tr>
<td>4.1% to 5.0%</td>
<td>1</td>
</tr>
<tr>
<td>Beyond 5%</td>
<td>0</td>
</tr>
</tbody>
</table>

In the scoring guide all the responses have been categorized for flexibility and originality scoring.

If there are cases in which some responses, which are not included in the scoring guide, the test user can work out the originality weight for these new responses according to the scoring scheme.

**4.15 STATISTICAL TECHNIQUES FOLLOWED IN THIS STUDY**

In different analysis the significant difference between groups were studied by using mean, standard deviation and ‘t’ test. The co-efficient of correlation was determined by using Pearson product moment method. Also regression analysis was used in this study.
4.16 CONCLUSION

The restatement of the problem, objectives, variables, hypotheses, design of the study, research and experimental procedure, sample, tools, reliability and validity of tools, data collection, scoring and statistical techniques followed in the present investigation were discussed in this chapter. The collected data were analyzed by using appropriate statistical techniques and they are presented in the next chapter.